

State of California
Regional Water Quality Control Board
North Coast Region

March 10, 2004
David A. Kuszmar

EXECUTIVE OFFICER'S SUMMARY REPORT
9:00 a.m., March 24, 2004
Regional Water Quality Control Board
5550 Skylane Blvd, Suite A
Santa Rosa, California

ITEM: 10 (Supplemental)

SUBJECT: Five Watersheds Monitoring Report

INTRODUCTION

The Regional Water Board has expressed substantial interest in using water quality monitoring data as a tool to make informed decisions related to water quality protection in areas where timber harvesting is the prevailing land use. In particular, beginning with a set of motions approved at its December 5, 2002 meeting, the Regional Water Board has directed staff to pursue monitoring for various objectives in Elk River, Freshwater, Bear, Jordan, and Stitz Creeks (the Five Watersheds). Regional Water Board staff, in conjunction with major landowners, community groups, and state and federal agencies have made significant progress toward implementing monitoring programs consistent with the Board's direction.

This report is presented in two main sections, following a format similar to that of a previous monitoring report for the Five Watersheds, which was presented to the Board approximately one year ago.¹ The first section summarizes the status of water quality monitoring projects currently underway in the Five Watersheds. The second section provides an evaluation of existing data generated for projects that have been specifically ordered or otherwise requested by the State and Regional Water Boards.

STATUS OF ONGOING WATER QUALITY MONITORING ACTIVITIES IN THE FIVE WATERSHEDS

To varying degrees, water quality monitoring activities are underway in each of the Five Watersheds for an assortment of monitoring objectives.² These activities are primarily conducted by four organizations: Salmon Forever (a local volunteer organization), Humboldt State University (HSU), the Simpson Resource Company, and the Pacific Lumber Company. In some cases, monitoring is conducted voluntarily. In other cases, monitoring is conducted in accordance with orders issued pursuant to section 13267(b) of the California Water Code.

¹ The previous report titled "Monitoring Report for Five Humboldt County Watersheds: Elk River and Freshwater, Jordan, Bear, and Stitz Creek Watersheds," appeared as a supplement to the Executive Officer's Summary Report for Regional Water Board Meeting Agenda Item 17, as listed on the March 27, 2003 meeting agenda.

² For purposes of this report, all references to monitoring objectives are consistent with the definitions provided in Attachment D.

Further, some monitoring is conducted in accordance with the Pacific Lumber Company's Habitat Conservation Plan (HCP).

Salmon Forever and HSU's water quality monitoring efforts are designed to inform the 303(d) and Total Maximum Daily Load (TMDL) processes, and may be best described as assessment and/or trends monitoring. Other monitoring efforts by the Simpson Resource Company and the Pacific Lumber Company were developed per the direction of the Regional Water Board and are designed to: (1) facilitate the development of TMDLs, (2) assess compliance with water quality objectives, (3) allow for timely detection and remediation of sediment discharges, and (4) determine trends in water quality over time in the Five Watersheds. Monitoring required under the Pacific Lumber Company's HCP is designed to meet many of the same objectives.

Table 1 contains a basic summary of water quality monitoring activities currently underway in the Five Watersheds, categorized by monitoring objective and responsible organization. Attachments A, B and C illustrate instream locations associated with these activities. Following Table 1 are detailed discussions regarding activities associated with each monitoring objective. We note that many of these monitoring endeavors are still relatively new (i.e., in their first or second year of implementation), and data generated to date thus do not yet allow us to draw specific conclusions. However, as requested by the Regional Water Board, this report provides an inventory of projects currently underway and data analysis where sufficient data are available.

Table 1. Summary of Ongoing Water Quality Monitoring Activities in the Five Watersheds.

Monitoring Objective	Elk River (27,500 acres)	Freshwater Creek (19,900 acres)	Bear Creek (5,500 acres)	Jordan Creek (3,100 acres)	Stitz Creek (2,600 acres)
Assessment / TMDL	S P H	S P R			
Trends	S P H	S P R	P	P	P
Basin Plan Compliance	P	P R			
Forensic	P	P R			
Effectiveness					
S = Salmon Forever P = Pacific Lumber Co. R = Simpson Resource Co. H = Humboldt State					

Assessment / TMDL Development Monitoring

The main goal of assessment monitoring is to characterize existing water quality conditions, usually taken as a "snapshot" at a watershed scale. Data from this type of monitoring are being used to inform the TMDL development process in the Elk River and Freshwater Creek watersheds, eventually allowing for the establishment of geologically-sensitive numeric targets for the TMDLs.

During the last winter period (2002-2003), Salmon Forever, the Simpson Resource Company, and the Pacific Lumber Company collected data in both the Elk River and Freshwater Creek watersheds for the purposes of TMDL development. Cooperative agreements and monitoring orders associated with these efforts required data collection for only one year, and therefore are no longer in effect. However, due to delays in the development of the TMDLs, ongoing trends monitoring in Elk River and Freshwater Creek by all three groups, as well as additional efforts

by HSU, may yield additional data in time to be considered for the TMDL development process. Consequently, Table 1 and Attachments A and B indicate that some monitoring activities for Assessment/TMDL development objectives are still underway.

Trends Monitoring

The main goal of trends monitoring is to characterize changes in water quality conditions over time, usually at a watershed scale. Trends monitoring is essentially equivalent to assessment monitoring carried out over an extended course of time.

All instream locations associated with trends monitoring in the Five Watersheds are shown in Attachments A, B, and C. As indicated by those attachments and by the focus of the discussion below, the large majority of ongoing trends monitoring activities for water quality parameters in the Five Watersheds is conducted by the Pacific Lumber Company. However, it is important to note that ongoing sediment monitoring efforts by Salmon Forever, HSU, and the Simpson Resource Company do qualify as trends monitoring, and provide data of comparable value.

As part of its HCP, the Pacific Lumber Company administers an extensive trends monitoring program across its ownership for the multiple parameters, including: % fines (bulk sediment), D₅₀ (pebble counts), water temperature, macro-invertebrates, % cover (canopy), habitat typing, cross-sections and thalweg profiles (channel surveys), pool fish density, spawner/carcass presence, and large woody debris. Generally speaking, of these parameters, data related to bulk sediment samples, pebble counts, water temperature, and physical habitat characteristics are the most potentially useful to the Regional Water Board.

Table 2 summarizes the current coverage of the Pacific Lumber Company's trends monitoring efforts for water quality parameters in the Five Watersheds. The company recently expanded its trends monitoring program for a number of sites in the Five Watersheds by incorporating water column parameters, including stage and streamflow, turbidity, suspended sediment concentration, and rainfall. Using techniques such as in-situ measurement, point and depth-integrated grab sampling, and fully automated Turbidity Threshold Sampling, the company generates continuous records that are used to develop an assortment of valuable data products. In much the same fashion, the Simpson Resource Company has committed to maintaining a trends monitoring station near the mouth of Ryan Creek. Salmon Forever and HSU operate similar stations in Elk River and Freshwater Creek.

Table 2. Water Quality Data Currently Collected at Pacific Lumber Company's Trends Monitoring Stations in the Five Watersheds.

Drainage	Station	Stream Name	Water Quality Data			
Freshwater Creek			Turbidity / SSC	Bulk Sediment	Pebble Counts	Water Temp. Channel Survey
(526)	36	Mainstem Freshwater	x	x	x	x
	502	Mainstem Freshwater	x			
	165	Mainstem Freshwater		x	x	
(506)	15	South Fork Freshwater	x	x	x	x
	34	Mainstem Freshwater		x	x	
	32	Mainstem Freshwater		x	x	x
(505)	19	Graham Gulch	x	x	x	
(504)	92	Cloney Gulch	x	x	x	x
(527)	135	McCready Gulch	x	x	x	x
(528)	18	Little Freshwater	x	x	x	x
Elk River						
	90	North Fork Elk		x	x	x
	91	North Branch NF Elk		x	x	x
	104	South Branch NF Elk		x	x	x
(512)	167	North Fork Elk	x	x	x	
	162	North Fork Elk		x	x	x
(517)	168	Bridge Creek	x	x	x	x
	14	North Fork Elk		x	x	x
	511	North Fork Elk	x			
	188	South Fork Elk	x			
	183	South Fork Elk	x			
(510)	175	South Fork Elk	x	x	x	x
(509)	166	Mainstem Elk	x	x	x	x
Lower Eel River						
	120	Bear Creek		x	x	x
	107	Bear Creek		x	x	x
(530)	89	Bear Creek	x			x
(529)	174	Jordan Creek	x	x	x	x

In concert with efforts related to its HCP, the Pacific Lumber Company conducts trends monitoring in Elk River and Bear Creek (specifically) to satisfy requirements originally set forth by Regional Water Board staff pursuant to section 13267(b) of the California Water Code in a letter dated July 30, 1999. Monitoring efforts conducted by the company in these watersheds were designed such that they could simultaneously meet requirements specified in the HCP and in the Regional Water Board staff's letter.

Building on the existing trends monitoring framework in the Bear, Jordan, and Stitz Creek watersheds, recent efforts by Pacific Lumber Company and Regional Water Board staff have led to a new cooperative agreement that will provide additional information where crucial trends monitoring data gaps still exist. The agreement consists of the following elements.

- Continuous stage and turbidity measurements, streamflow measurements, and sampling for suspended sediment concentrations (Bear and Jordan)
- Precipitation monitoring at mid-slope and ridge-top locations (Bear)
- Outmigrant smolt monitoring (Bear)
- Intense channel surveys (Bear, Jordan, Stitz)

Specifications for the time-critical elements of the agreement (instream sediment, streamflow, and precipitation) were developed and implemented in time for the 2003-2004 winter period. Specifications for the remaining elements (smolt monitoring and channel surveys) have yet to be fully developed, but should be completed and implemented in time for the next available sampling periods (i.e., smolt monitoring in the spring, channel surveys in the summer). One possible exception, however, may be that the acquisition of required state and federal permits for trapping listed species of fish will delay the full implementation of outmigrant smolt monitoring until the spring of 2005.

We note that continuous stage and turbidity monitoring were considered for Stitz Creek, but found to be unreasonable because of safety concerns. Also, due to the close proximity of Bear, Jordan, and Stitz Creeks, precipitation data collected in the Bear Creek drainage are presumed to be sufficiently representative for all three watersheds.

Basin Plan Compliance Monitoring

The main goal of Basin Plan compliance monitoring is to determine whether discharges resulting from land use activities meet water quality standards, as outlined in the Basin Plan, usually conducted at a project-level scale. To be effective, Timber Harvesting Plan (THP)-specific compliance monitoring must typically use parameters that can detect changes in instream conditions fairly quickly (such as turbidity and suspended sediment) because the life of THPs is short (i.e., 3-5 years). Determinations of compliance using instream parameters require study designs to offer some opportunity for comparison between “control” and “treatment” pairs. This comparison is often made by evaluating conditions in terms of: before vs. after, upstream vs. downstream, untreated vs. treated, or some combination thereof. While desirable for many projects, Basin Plan compliance monitoring can only be applied to a limited number of sites, due to the need for a full complement of favorable site-specific conditions, including safe access, flow regime, channel shape, and others.

All instream locations associated with Basin Plan compliance monitoring in the Five Watersheds are shown in Attachments A, B, and C. Currently, three THPs in the Five Watersheds are subject to Basin Plan compliance monitoring programs that are attributable to Regional and State Water Board directives. In October 2001, the State Water Resources Control Board (SWRCB) issued Order No. WQ-2001-14 to the Pacific Lumber Company requiring monitoring and reporting activities associated with THP 1-97-520 HUM (THP 520), a project located in South Fork Elk River. The following year, Regional Water Board staff developed cooperative monitoring agreements with both the Simpson Resource Company and the Pacific Lumber Company for additional projects. Beginning with the 2002-2003 winter period, the Simpson Resource Company initiated a monitoring program associated with THP 1-02-027 HUM (THP 027) in the Ryan Creek watershed, tributary to Freshwater Creek. The Pacific Lumber Company initiated a similar, though more extensive, program associated with THP 1-01-201 HUM (THP 201) in the mainstem portion of the Freshwater Creek drainage. Each of these monitoring projects has resulted in a mixture of success and lessons learned, some of which are described later in this report. Regional Water Board staff continue to work with the Simpson Resource Company and the Pacific Lumber Company to make necessary changes and improvements to each project such that the stated monitoring objectives may be met.

In addition to the THP-specific monitoring activities described above, the Pacific Lumber Company conducts grab sampling at specific watercourse crossing sites along major haul roads used by the company for winter operations in THPs covered by Waste Discharge Requirements (WDRs) recently issued by the Regional Water Board. This type of monitoring best fits the description of Basin Plan compliance monitoring, but it is conducted at a much smaller scale than that which has been implemented on entire THPs.

Forensic Monitoring

The main goal of forensic monitoring is to identify pollutant sources in a timely manner and to respond to them with appropriate remedial efforts, usually conducted at a project-level scale. Forensic monitoring often goes hand-in-hand with Basin Plan compliance monitoring because instream data collected under the latter may be used to trigger forensic hillslope inspections. Each of the THP-specific monitoring plans described in the previous section utilizes forensic inspections to some degree. Additionally, WDRs issued to date for winter operations in the Pacific Lumber Company's Elk River THPs contain an element of forensic monitoring in the form of before-and-after hillslope inspections.

Effectiveness Monitoring

The main goal of effectiveness monitoring is to determine whether particular land-management prescriptions are effective at achieving desired results, usually at a prescription-level scale. Where these desired results correspond to Basin Plan water quality standards, some have used the terms "effectiveness monitoring" and "Basin Plan compliance monitoring" synonymously. However, Regional Water Board staff reserve the use of the term "effectiveness monitoring" for projects with study designs that isolate particular prescriptions and evaluate their performance in a carefully considered statistical framework over a wide range of spatial and temporal conditions (i.e., not just at a single site). Regional Water Board staff are particularly interested in *instream* effectiveness monitoring, which applies to the evaluation of land management prescriptions that were developed specifically for the protection of water quality.

With one possible exception, Regional Water Board staff are not aware of any instream effectiveness monitoring programs underway in the Five Watersheds. Ideally, prescriptions designed to protect water quality in the Forest Practice Rules and other prescriptive management plans (e.g., the Pacific Lumber Company's HCP) will be evaluated in large-scale studies to determine whether those prescriptions produce desired results. The Board of Forestry's Monitoring Study Group is one entity pursuing such efforts on behalf of the Forest Practice Rules. Additionally, the Pacific Lumber Company's HCP does require that such monitoring be conducted to inform adaptive management on the company's lands.

The possible exception noted above refers to a number of THP-specific water quality monitoring projects recently initiated in Freshwater Creek by the Pacific Lumber Company. The projects are required by the HCP signatory agencies as a condition of implementing new land management prescriptions adopted through the HCP's Watershed Analysis process. While Regional Board staff are aware that such monitoring activities have begun, we are not yet familiar with the monitoring locations or the sampling designs associated with these activities.

Additional Monitoring Activities

In an effort to provide the Regional Water Board with a manageable volume of information, discussions provided in this report are limited specifically to *water quality* monitoring activities in the Five Watersheds. In this context, the term water quality monitoring refers to the use of instream parameters, particularly those related to sediment, the dominant pollutant of concern in the Five Watersheds. However, we note that volunteer groups, timber companies, state and federal agencies and others collect additional data in these watersheds related to species presence, road performance, and other watershed attributes of interest to resource managers and regulatory entities. Some of these efforts that could arguably have been included in this report include additional trends monitoring efforts by the Pacific Lumber Company, outmigrant smolt monitoring by the Department of Fish and Game, and hillslope effectiveness monitoring by the California Department of Forestry and Fire Protection, among others.

EVALUATION OF EXISTING DATA FROM WATER QUALITY MONITORING ACTIVITIES IN THE FIVE WATERSHEDS

While the previous section of this report referred to all water quality monitoring activities currently conducted by multiple groups in the Five Watersheds, the following evaluation pertains only to those projects that have been specifically ordered or otherwise requested by the State and Regional Water Boards. A complete list of monitoring projects that meet this criterion is provided in Table 3.

Table 3. Ongoing Monitoring Projects Specifically Ordered or Otherwise Requested by the State and Regional Water Boards in the Five Watersheds.

Objective	Project Name	Responsible Party	Implementation
Assessment / TMDL Development			
	Freshwater Creek TMDL Development	Pacific Lumber Co.	Cooperative
	Elk River TMDL Development	Pacific Lumber Co.	Cooperative
Trends Monitoring			
	Freshwater Creek Trends	Pacific Lumber Co.	Cooperative
	Elk River Trends	Pacific Lumber Co.	Cooperative / Order
	Bear Creek Trends	Pacific Lumber Co.	Cooperative / Order
	Jordan Creek Trends	Pacific Lumber Co.	Cooperative
	Stitz Creek Trends	Pacific Lumber Co.	Cooperative
Basin Plan Compliance / Forensic			
	THP 520 Monitoring **	Pacific Lumber Co.	Order No. WQ-2001-0014
	THP 201 Monitoring *	Pacific Lumber Co.	Cooperative
	THP 027 Monitoring *	Simpson Resource Co.	Cooperative
	Elk River WDRs Monitoring	Pacific Lumber Co.	Order No. R1-2003-0118
	Freshwater Creek WDRs Monitoring	Pacific Lumber Co.	Order No. R1-2003-0119

* THP is located in the Freshwater Creek watershed

** THP is located in the Elk River watershed

As previously mentioned, many of the monitoring projects underway in the Five Watersheds, including those listed in Table 3, are still relatively new, and data generated to date thus do not yet allow us to draw specific conclusions. As such, the bulk of the following evaluation is limited to brief comments regarding project implementation and quality assurance, a “snapshot” assessment of available trends monitoring data, and foreseeable analysis of data sets under construction. As data continue to be collected and reported, successive monitoring evaluations by Regional Water Board staff will contain larger sections devoted to data analysis.

Project Implementation

With few exceptions, the projects itemized in Table 3 have been implemented by the responsible parties in good faith, and in accordance with specifications provided by the State and Regional Water Boards. The majority of these projects suffered initial delays in implementation due to such factors as lack of available equipment, unforeseen complications at certain monitoring sites, and needed lag time for hiring and training of monitoring staff. Additionally, the development of needed quality assurance documents proves to be time-intensive, and thus results in further delays in project implementation. Despite these initial delays, the large majority of new projects listed in Table 3 are fully instrumented and online, and are currently in the midst of a second sampling season.

Thus far, each monitoring project ordered or otherwise requested by the State and Regional Water Boards has, to some degree, achieved the project’s stated monitoring objectives. However, project outputs have highlighted the need for improvements in a variety of areas, including sampling design, selection of appropriate monitoring locations and instream equipment, preparation and approval of quality assurance documents, simultaneous management of multiple projects, personnel training, and data validation methods. Staff from both the Simpson Resource Company and the Pacific Lumber Company have worked in earnest with Regional Water Board staff to address unforeseen complications during project implementation and to provide greater assurance that stated monitoring objectives will be met.

Quality Assurance

To ensure that data collected for a monitoring project are of sufficient quality to meet stated monitoring objectives, Regional Water Board staff require that a collection of quality assurance measures be incorporated into each project. To promote the successful development of such measures, we rely in large part on guidance available from the US Environmental Protection Agency (EPA). The EPA Quality System is a highly developed and widely accepted organizational structure that provides guidance to anyone who wishes to conduct environmental monitoring. Prior to implementation, the EPA requires each monitoring project it funds to have an approved Quality Assurance Project Plan (QAPP) in place. While the monitoring projects itemized in Table 3 are obviously not funded by the EPA, nor by the Regional Water Board, the EPA Quality System remains an appropriate model for those projects to follow.

The concept of QAPP development for monitoring projects dealing with non-point-source pollutants (especially in forested watersheds) is still relatively new to landowners in the North Coast Region. As such, QAPP development has represented a significant capital cost to landowners and other groups intending to conduct monitoring activities in accordance with data

quality standards specified by Regional Water Board staff and the EPA. This has been especially true for landowners developing QAPPs for the first time. Due to an initially steep “learning curve” for QAPP development, quality assurance documents have taken substantial time to develop and review. Nevertheless, draft QAPPs developed by the Simpson Resource Company and the Pacific Lumber Company are currently on file at the Regional Water Board office for each of the monitoring projects listed in Table 3, with a few minor exceptions.³

Regional Water Board staff initially intended to play a significant role in the development of each QAPP on file, and to officially approve each document. However, the sheer volume of quality assurance documentation associated with each monitoring project, as well as the rapid rate of changes made to such documentation as first-year projects evolved, have proved that our intentions were unrealistic. As an alternative to conducting an overwhelming loop of document reviews, Regional Water Board staff met repeatedly with monitoring staff from the responsible parties, and familiarized ourselves with each project by witnessing first-hand the implementation of quality assurance measures and standard operating procedures being used. Based on these efforts, and upon review of the data we’ve received to date, we are reasonably confident that the data collected under the current draft QAPPs are of sufficient quality to meet the stated monitoring objectives for each project.

Snapshot Analysis of Trends Monitoring Data

Trends monitoring data available from the Pacific Lumber Company comprise the longest-lived data set in the Five Watersheds, spanning back to 1998 for some sites. Classically, such data sets are analyzed by applying linear regression models to data collected over successive years. The slope of the regression line is evaluated to determine whether desired conditions are being approached over time. Unfortunately, for a group of key parameters described below, an exhaustive regression analysis of trends monitoring data collected to date in the Five Watersheds leads to few conclusions regarding ongoing changes in water quality conditions. This is due to a combination of factors, including natural variability, inconsistent methods and data quality measures implemented during the first years of the monitoring program, and the use of channel parameters that respond relatively slowly to changing water quality conditions.

Some of the more promising water quality parameters historically measured under the Pacific Lumber Company’s trends monitoring program are related to bulk sediment samples, pebble counts, water temperature, and physical habitat characteristics. Key parameters evaluated for purposes of this report are listed in Table 4, along with targets defined for those parameters in the Properly Functioning Conditions matrix for the Pacific Lumber Company’s HCP. At the majority of trends monitoring sites in the Five Watersheds, the parameters listed in Table 4 have exhibited sufficient variability over time such that we can draw few conclusions relative to *changes* in water quality conditions. However, a simpler “snapshot” analysis of the most recent data set (i.e., data collected in 2002 and reported in 2003) provides some understanding of *current* water quality conditions in the Five Watersheds, provided that the limits of such an

³ Exceptions include: trends monitoring conducted by the Pacific Lumber Company in Elk River and Bear Creek as required in a July 30, 1999 letter from Regional Water Board staff, and Basin Plan compliance and forensic monitoring by the Simpson Resource Company for THP 027. Preparation of fully developed QAPPs for these projects was not required.

analysis are understood. For instance, the five parameters evaluated do not necessarily paint a full picture of all aspects of water quality. Additionally, targets in the HCP's Properly Functioning Conditions matrix cannot necessarily be considered surrogates for Basin Plan water quality objectives.

Table 4. Key Water Quality Parameters Historically Collected Under Pacific Lumber Company's Trends Monitoring Program.

Parameter	Description / Significance	Target Value*
% Fines < 0.85 mm	Fraction of substrate composed of particles smaller than fine sands; correlated to decrease in embryo survival for anadromous fish species due to reduction in gravel permeability, pore space, and dissolved oxygen.	< 11-16%
% Fines < 6.35 mm	Fraction of substrate composed of particles smaller than small gravels; correlated to entrapment of Chinook and Steelhead fry emerging from redds.	< 20-25%
D ₅₀ (mm)	Median substrate particle size; correlated to quality of rearing habitat for anadromous fish species.	65-95 mm
Maximum Weekly Average Temperature (MWAT, °C)	Derived from a running average of temperature measurements taken during late summer flows; correlated to juvenile rearing for anadromous fish species.	< 16.8 °C
Average Residual Pool Depth (ft)	Average pool depth for all pools in a specified stream reach; correlated to available refugia from predators, high temperatures, and high velocities for anadromous fish species.	>= 3 ft.

* Target values are taken directly from the Properly Functioning Conditions matrix for Pacific Lumber Company's HCP.

Figures 1-5 present data available for the key parameters listed in Table 4 for all trends monitoring sites in the Five Watersheds. Each figure provides a "snapshot" of current conditions relative to the subject parameter, and compares those conditions with target values from the HCP's Properly Functioning Conditions matrix. Generally speaking, the data suggest that targets for % fines < 0.85mm and maximum weekly average temperatures are currently being met at most locations in the Five Watersheds, whereas targets for % fines > 6.35mm, D₅₀, and average residual pool depths are currently not being met. The data may also be used to highlight particular locations in the Five Watersheds where conditions may warrant a closer examination, due to highly favorable or unfavorable performance against target values.

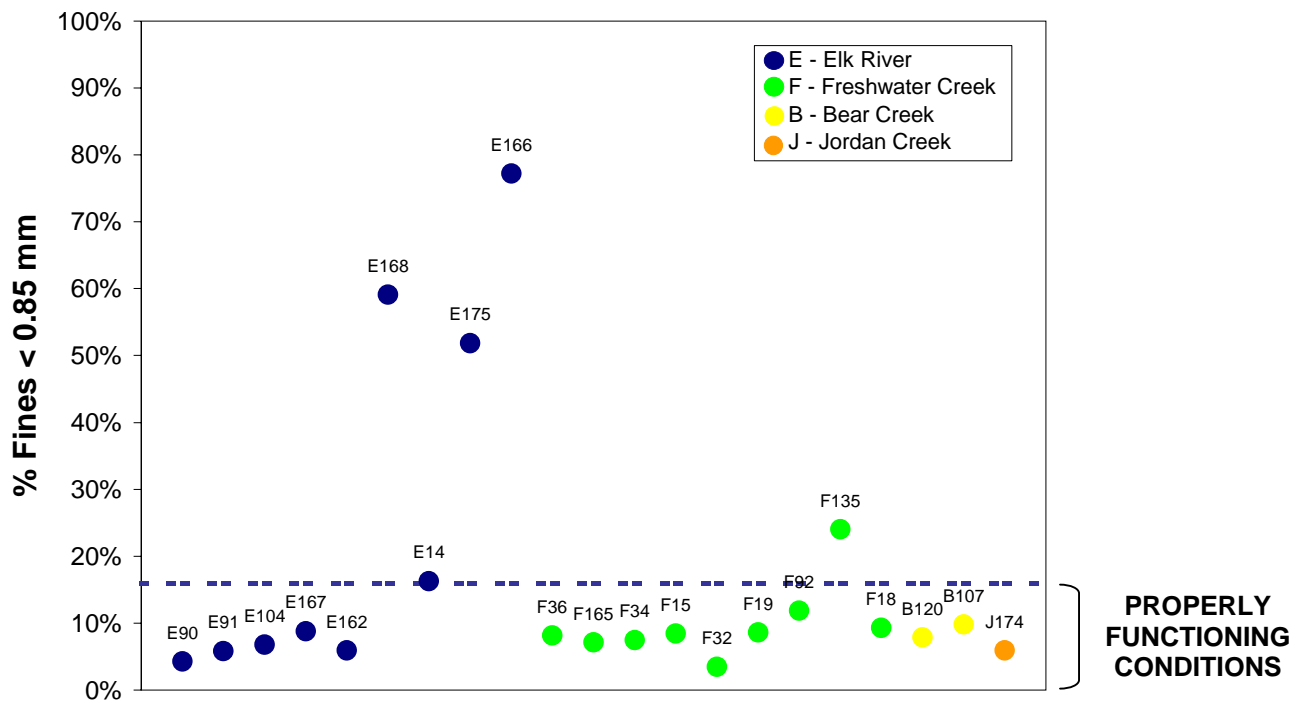


Figure 1. Percent Fines < 0.85mm Reported for Pacific Lumber Company Trends Monitoring Stations in the Five Watersheds in 2002.

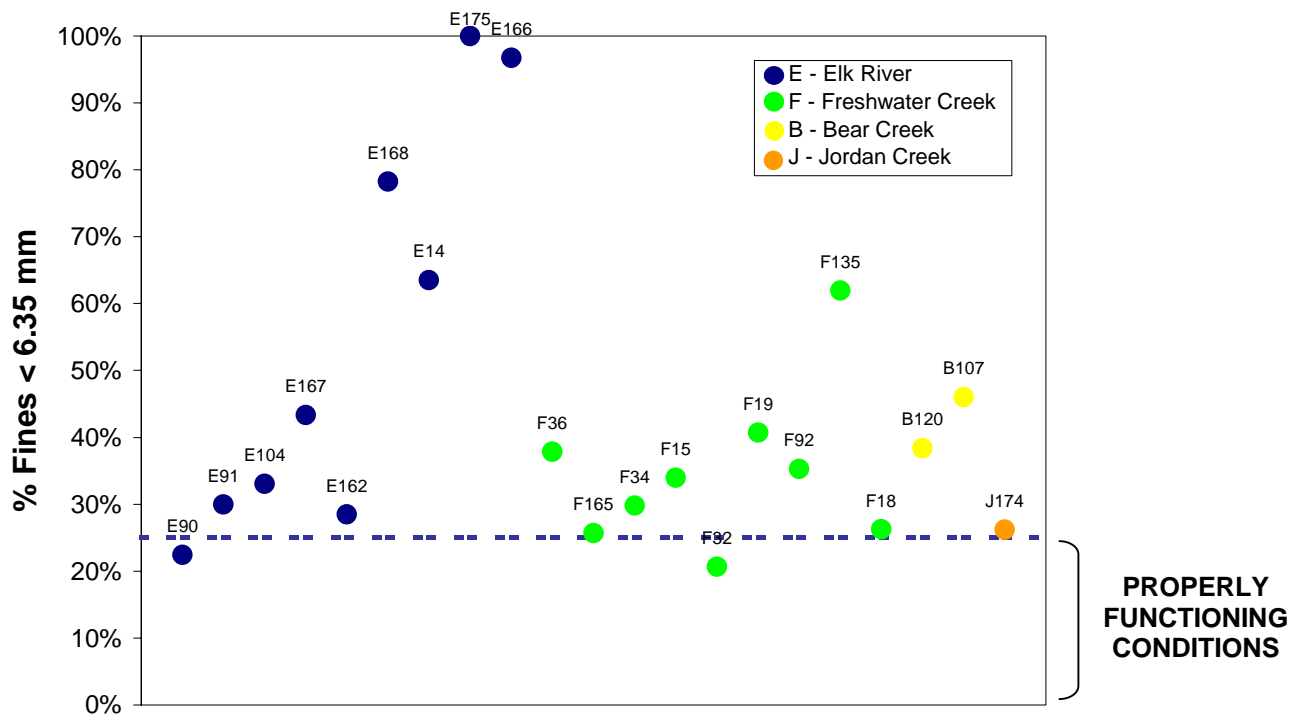


Figure 2. Percent Fines < 6.35mm Reported for Pacific Lumber Company Trends Monitoring Stations in the Five Watersheds in 2002.

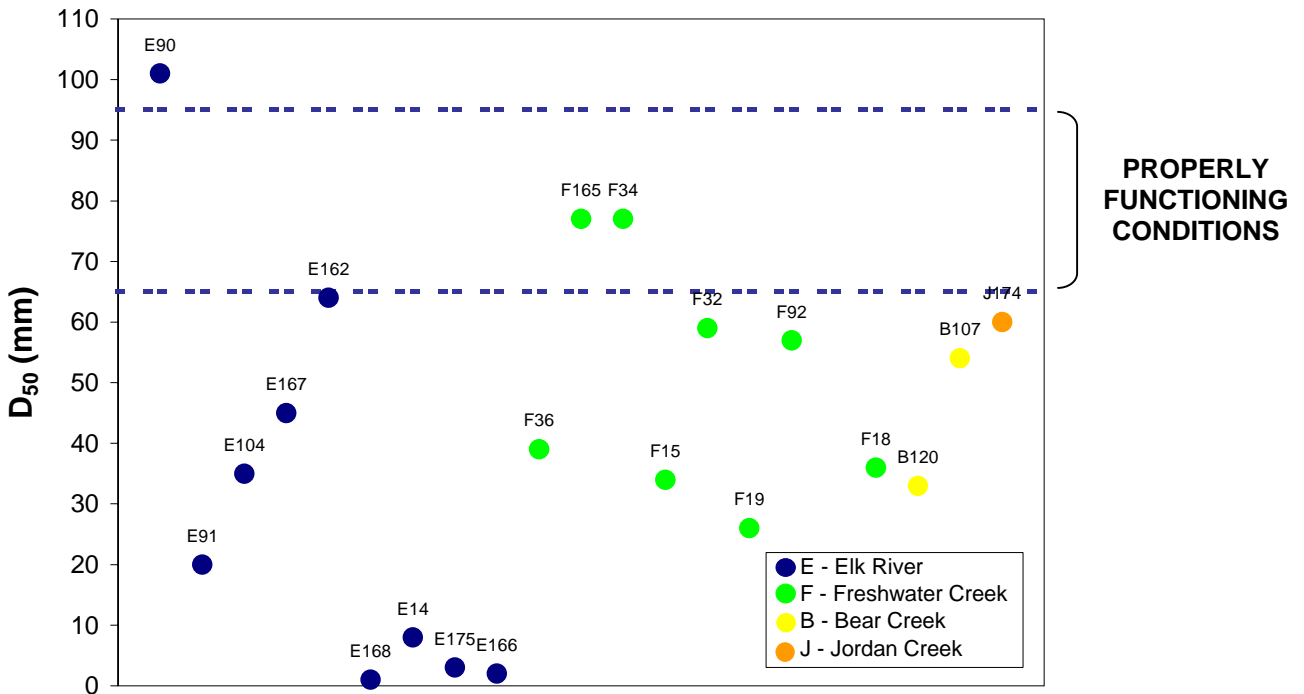


Figure 3. D₅₀ Values Reported for Pacific Lumber Company Trends Monitoring Stations in the Five Watersheds in 2002.

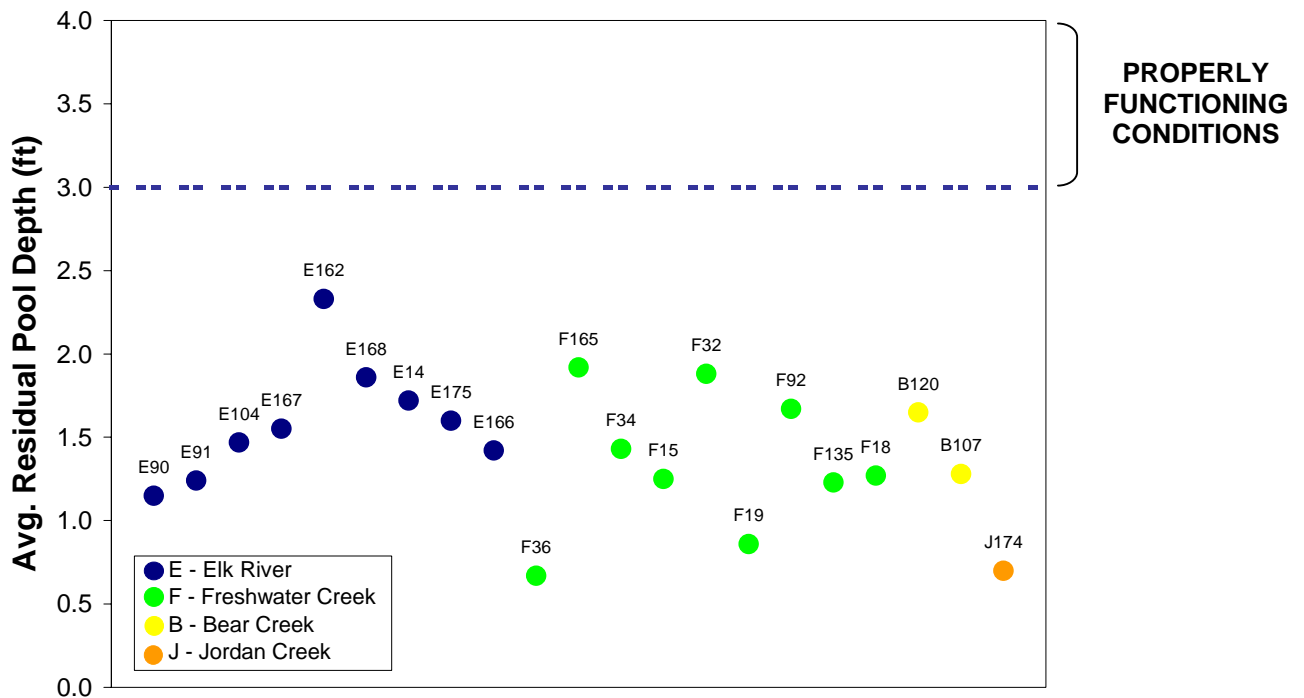


Figure 4. Average Residual Pool Depths Reported for Pacific Lumber Company Trends Monitoring Stations in the Five Watersheds in 2002.

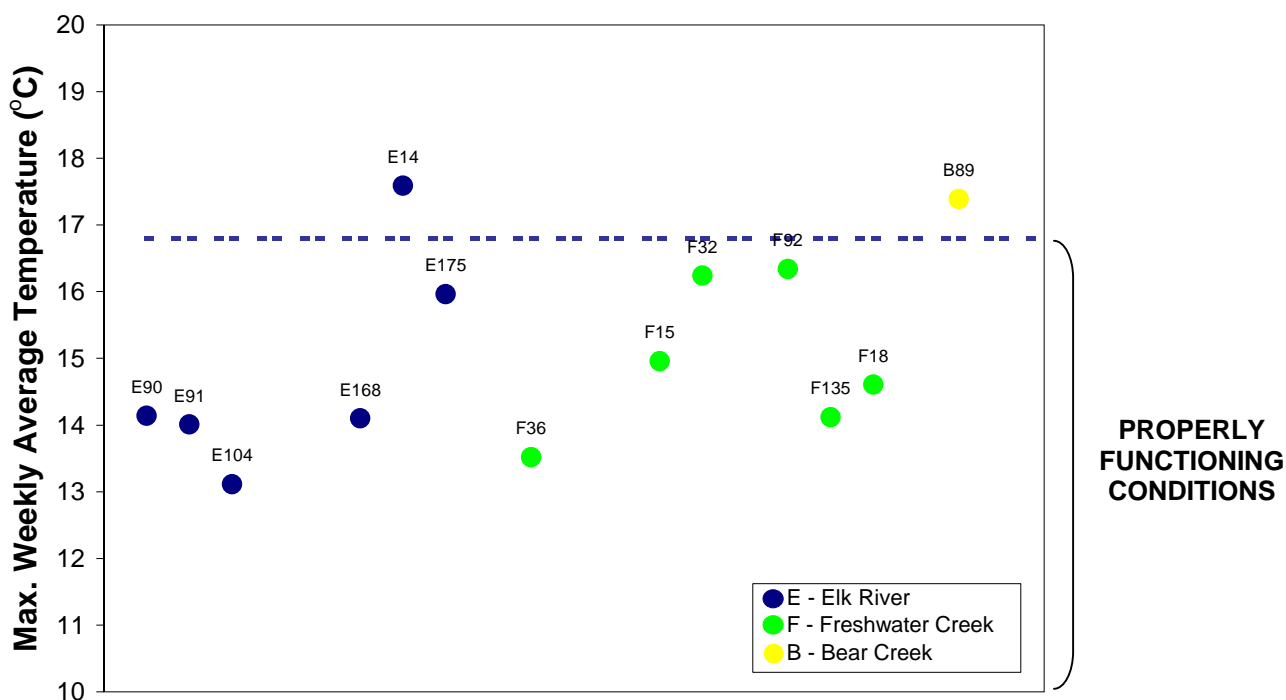


Figure 5. Maximum Weekly Average Temperatures Reported for Pacific Lumber Company Trends Monitoring Stations in the Five Watersheds in 2002.

Foreseeable Analysis of Data Sets Under Construction

Foreseeable analyses of data associated with ongoing Basin Plan compliance, TMDL development, and trends monitoring will rely on regression techniques when relationships between stage, streamflow, turbidity, and suspended sediment concentrations are of primary interest. The classic approach to evaluating data for these parameters begins with the development of the following fundamental relationships:

- Stage vs. Streamflow
- Streamflow vs. Turbidity
- Turbidity vs. Suspended sediment concentration

Additionally, to address some questions related to quality assurance, the following relationships may also be of interest, depending on the specific sampling techniques and equipment used:

- Point samples vs. Depth-integrated samples (for suspended sediment and turbidity)
- Instream probe readings vs. Laboratory measurements (for continuous turbidity)

Once these fundamental relationships are known for a particular site, they may be used in a variety of ways to meet different monitoring objectives. For Basin Plan compliance monitoring, differences in runoff characteristics may be detected by comparing streamflow-turbidity relationships between upstream and downstream sites, treated and untreated sites, or between pre- and post-harvest conditions at the same site. Combining these comparisons into a single analysis (i.e., pre- and post-treatment conditions between treated and untreated sites) yields

stronger results. Figure 6 provides an example of an upstream vs. downstream comparison that may be used under this type of analysis to evaluate the effects of a single timber harvest unit. In this case, assuming that streamflows between the two sites at any one time are essentially the same, statistically significant differences between relationships developed for data collected at upstream and downstream locations suggest that discharges from harvest activities have affected water quality conditions.

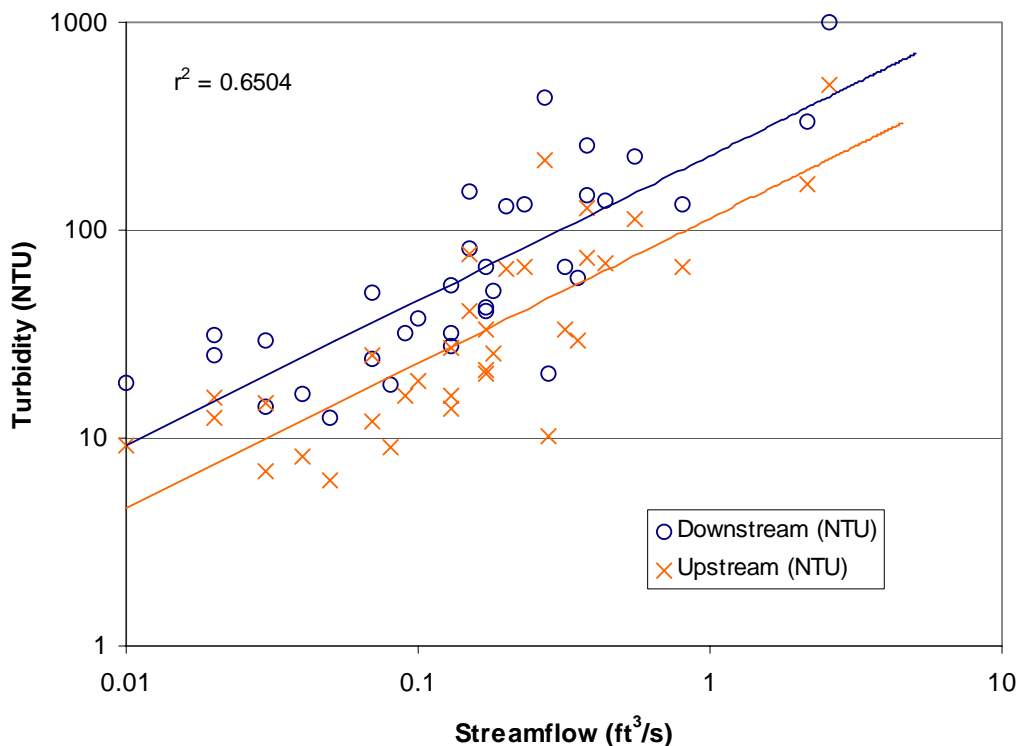


Figure 6. Example Comparison of Streamflow-Turbidity Relationships Used to Evaluate Basin Plan Compliance Monitoring Data.

In the case of TMDL development and/or assessment monitoring, the same fundamental relationships may be used to answer entirely different questions. While most TMDL development applications are beyond the scope of this report, the following is a demonstration of one simple technique for evaluating assessment monitoring data.

A continuous time series of turbidity or suspended sediment data may be constructed and used to evaluate water quality in terms of physiological effects on juvenile salmonids. Numerous studies (mostly conducted in laboratory settings) have linked fish health with exposures to turbidity and suspended sediment concentrations, especially under chronically turbid conditions. These studies suggest that, given extended exposures to certain levels of turbidity and suspended sediment, juvenile salmonids suffer effects such as behavioral changes, reduced feeding efficiency, reduced growth, and increased mortality. Results from these studies give rise to promising new approaches for evaluating water quality data.

Figure 7 provides an example of one approach that may be used characterize water quality conditions using physiologically significant turbidity thresholds. In this example, two thresholds are used: 25 NTUs corresponds to reduced fish growth and 70 NTUs corresponds to reduced feeding and avoidance behavior. According to the data presented, turbidity levels at Pacific Lumber Company trends monitoring station No. 510 in South Fork Elk River exceeded 25 NTUs approximately 83% of the time between March 15 and May 15, 2003. Similarly, exceedences of 70 NTUs occurred approximately 47% of the time.

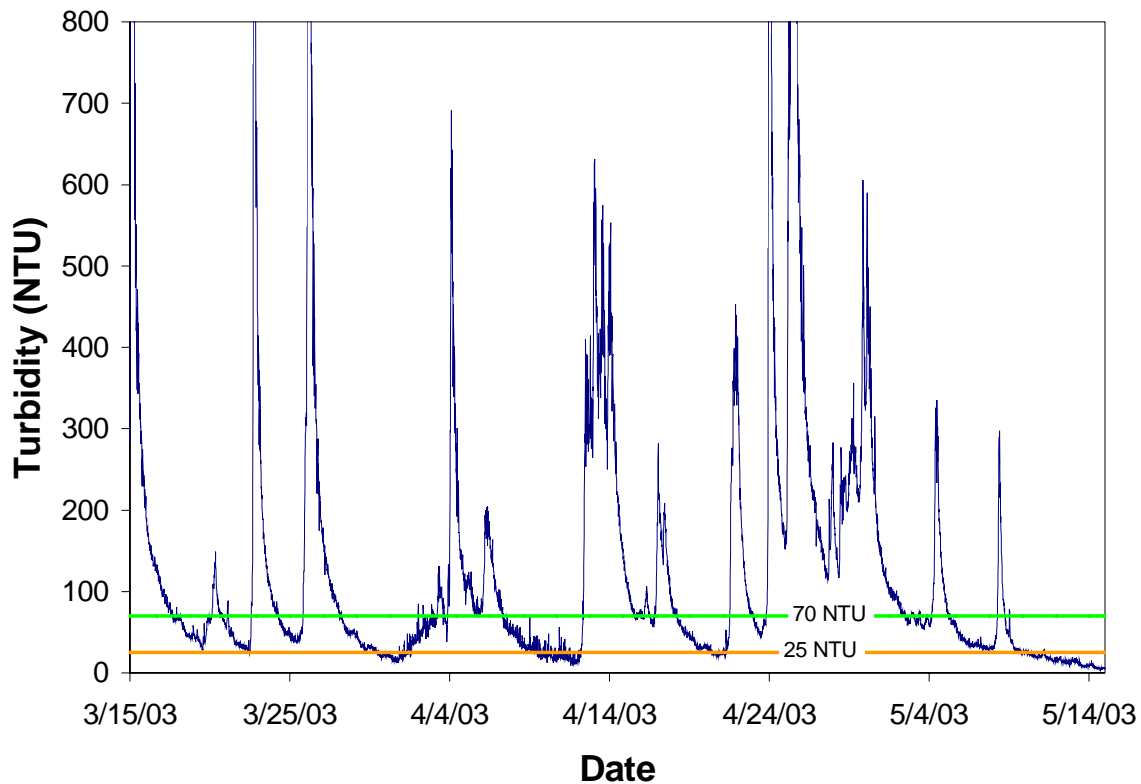


Figure 7. Turbidity Levels Reported for Pacific Lumber Company Trends Monitoring Station No. 510 in South Fork Elk River between March 15, 2003 and May 15, 2003.

Evaluating trends monitoring data such as those presented in the example above will eventually allow Regional Water Board staff to determine whether water quality conditions are improving or degrading over time at specific locations in the Five Watersheds. Cumulative turbidity threshold exceedences or other index parameters suggested in the scientific literature represent one avenue by which such determinations may be made using consecutive years of data. Once consecutive years of such data become available for the Five Watersheds, Regional Water Board staff will explore this topic in greater detail, and provide analyses in future monitoring reports.

**PRELIMINARY STAFF
RECOMMENDATION:**

No formal Regional Water Board action is required for this item, but the Board may provide guidance on work efforts related to monitoring activities in the Five Watersheds.